BROOKHAVEN NATIONAL LABORATORY
LASER CONTROLLED AREA
STANDARD OPERATING PROCEDURE (SOP)

This document defines the safety management program for the laser system listed below. All American National Standard Institute (ANSI) Hazard Class 3b and 4 laser systems must be documented, reviewed, and approved through use of this form. Each system must be reviewed annually.

System description: Single Event Upset Test Facility
Location: Building 901A – Target Room 4

LINE MANAGEMENT RESPONSIBILITIES

The Owner/Operator for this laser is listed below. The Owner/Operator is the Line Manager of the system and must ensure that work with this laser conforms to the guidance outlined in this form.

Owner/Operator:		
	Signature on File	
Name: Charles Carlson	*Signature:*	*Date:*

AUTHORIZATION

Work with all ANSI Class 3b and 4 laser systems must be planned and documented with this form. Laser system operators must understand and conform to the guidelines contained in this document. This form must be completed, reviewed, and approved before laser operations begin. The following signatures are required.

C. Weilandics	Signature on File	
BNL LSO printed name	*Signature*	*Date*
Asher Etkin	Signature on File	
C-A Department ES&H Approval printed name	*Signature*	*Date*

APPLICABLE LASER OPERATIONS
Operation Maintenance Service X Specific Operation Fiber Optics

LASER SYSTEM HAZARD ANALYSIS

Hazard analysis requires information about the laser system characteristics and the configuration of the beam distribution system. The analysis includes both laser (light) and non-laser hazards. A Nominal Hazard Zone (NHZ) analysis must be completed to aid in the identification of appropriate controls.

LASER SYSTEM CHARACTERISTICS					
Laser Type *(Argon, CO_2, etc.)*	Wavelengths	ANSI Class	Maximum Power or Energy/Pulse	Pulse Length	Repetition Rate
HeNe	632 nm	3B	15 mW(nom.)	na	na

☐ **Cryogen Use**

Describe type, quantity, and use.

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☐ **Chemicals & Compressed Gasses**

Describe type, quantity, and use.

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☒ **Electrical Hazards**

Description *(Describe the power supply to the system).*

110 VAC

☐ **Other Special Equipment**

Description *(Equipment used with the laser[s]).*

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Laser System Configuration: Describe the system controls *(keys, switch panels, computer controls),* beam path, and optics *(provide a functional/block diagram for complicated beam paths)*.

The laser is incorporated into the Single Event Upset Test Facility . The present arrangement allows for the operation of the laser as an alignment tool by directing the beam from the laser in an interlocked vacuum enclosure through a several meter long beam pipe and the image is observed via a CCTV camera inside the evacuated test chamber. At this point the irradiance(measured at 60 microwatts) of the beam renders it a Class II laser hazard were there to be a totally reflective specular reflection directed through the glass view port. A measurement of a specular reflection directed through this viewport off a piece of highly polished silicon yielded 25 microwatts also class II.

The laser is turned on via computer control which requires continuous vacuum in the chamber and beam line. The interlocks for this system are periodically checked annually and recorded

The laser and optics are housed within an enclosed box; access is by tool aided removal Alignment is achieved through hand holes in the side of the enclosure which eliminate eye exposure.

DEVELOP CONTROLS
IDENTIFY ES&H STANDARDS

Recognition, evaluation, and control of laser hazards are governed by the following documents.

American National Standards Institute (ANSI) Standard for Safe Use of Lasers;
(ANSI Z136.1-2000)

Laser Safety Subject Area

Brookhaven National Laboratory Environment Safety and Health Standard: 1.5.3 INTERLOCK SAFETY FOR PROTECTION OF PERSONNEL

ENGINEERING CONTROLS

☒ Beam Enclosures	☒ Protective Housing Interlocks	☐ Other
☒ Beam Stop or Attenuator	☐ Key Controls	
☐ Activation Warning System	☐ Other Interlocks	
☐ Ventilation	☐ Emission Delay	

Describe each of the controls in the space provided below this text. Interlocks and alarm systems must have a design review and must be operationally tested every six months. Controls incorporated by the laser manufacturer may be referenced in the manuals for these devices. **If any of the controls utilized in this installation requires a design review, a copy of the design review documentation and written testing protocol must be on file. Completed interlock testing checklists should be retained to document the testing history.**

Engineering Controls Description:

The laser operates from within a sealed enclosure and beam is transported through several meters of vacuum pipe to a test chamber. At the output of the chamber is a bolted steel high vacuum flange. Interlocks require continuous vacuum from the beam line to the test chamber prior to turning the laser on. This means there is no access to the beam.

ADMINISTRATIVE CONTROLS

☐ Laser Controlled Area ☒ Signs ☒ Labels ☐ Operating Limits

The format and wording of laser signs and labels are mandated by BNL and ANSI standards. Only the standard signs are acceptable. Standard signs are available from the BNL Laser Safety Officer.

All lasers must have a standard label indicating the system's wavelength, power, and ANSI hazard class. Required labels must remain legible and attached. The manufacturer should label commercial systems.

Standard Operating Procedures (SOPs) are required for laser system operation, maintenance (including alignment), and servicing. The SOPs need only contain the information necessary to perform these tasks and identify appropriate control measures including postings and personal protective equipment. The BNL Laser Safety Officer must approve SOPs and copies should be available at the laser installation for reference and field verification of stated control measures.

Administrative Controls Description:

The chamber is appropriately posted as per BNL Laser Safety Officer and Operating Procedure is attached. The sealed box containing the laser and optics is posted: "Box only to be removed by a Qualified Class IIIB or 4 Laser Operator with Notification of the Operations Supervisor". Hand holes are posted: "Alignment only by Qualified Class IIIB or 4 laser Operator.

CONFIGURATION CONTROL

A checklist must be developed for the purpose of verifying the placement and/or status of components that are used to mitigate hazards by configuration control. Examples include any protective housings, beam stops, beam enclosures, and any critical optics *(mirrors or lenses that could misdirect the beam and result in personnel hazard)*. Entries should also be included to ensure placement of required signs and labels and status of interlock verification. Completed checklists must be posted at the laser location. The checklist does not have to be redone unless there has been a system modification, extended shutdown, or change of operations.

PERSONAL PROTECTIVE EQUIPMENT

☐ Skin Protection ☐ Eye Wear

Skin Protection: For UV lasers or lasers that may generate incidental UV in excess of maximum permissible exposure (MPE) describe the nature of the hazard and the steps that will be taken to protect against the hazard.

Eye Wear: All laser protective eyewear must be clearly labeled with the optical density and wavelength for which protection is afforded. Eyewear should be stored in a designated sanitary location. Color - coding or other distinctive identification of laser protective eyewear is recommended in multi-laser environments. Eyewear must be routinely checked for cleanliness and lens surface damage.

1. For invisible beams, eye protection against the full beam must be worn at all times unless the beam is fully enclosed.
2. For visible beams, eye protection against the full beam must be worn at all times during gross beam alignment.
3. Where hazardous diffuse reflections are possible, eye protection with an adequate Optical Density for diffuse reflections must be worn within the nominal hazard zone at all times.
4. If you need to operate the laser without wearing eye protection against all wavelengths present, explain the precautions that will be taken to prevent eye injury.

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Define eyewear optical density requirements by calculation or manufacturer reference and list other factors considered for eyewear selection. The BNL Laser Safety Officer will assist with any required calculations.

EYE WEAR REQUIREMENTS					
Laser System Hazard	Wavelength (nm)	Calculated Intra-beam Optical Density	Diffuse Optical Density*	NHZ** (meters)	Appropriate Eye Wear***

* Diffuse ODs are calculated assuming a 600 second exposure, a viewing distance of 20 cm, perfect reflectivity, and viewing normal to the surface. The ODs required can decrease for more typical conditions in the laboratory.

**The Nominal Hazard Zone is that zone or distance inside which exists a hazard to the eye from a diffuse reflection (as well as direct or specularly reflected light) for the time specified, in this case, 600 seconds (10 minutes).

***Specified eyewear may not be the only possible option, but represents an approved choice; depending on other laser hazards present in the lab, other eyewear may be acceptable provided the optical densities are equivalent or greater than those required.

EYE WEAR SPECIFICATIONS		
Laser System Eyewear Identification	Wavelengths	Optical Density

TRAINING

LASER SAFETY TRAINING

Laser Operators must complete sufficient training to assure that they can identify and control the risks presented by the laser systems they use. Owners/Operators and Qualified Laser Operators must complete the awareness level BNL World Wide Web based training course (TQ-LASER) every two years.

Qualified Laser Operators must also complete system-specific orientation with the system owner/operator. **System-specific training must be documented with a checklist that includes**

- Trainee name and signature
- Owner/Operator signature
- Date
- Brief list of topics covered e.g.
  - Review of SOPs;
  - Review of working procedures, and other program specific documentation.

All laser safety training must be repeated every two years.

See BTMS

TO BE REPLACED BY Laser Specific JTA in BTMS

Qualified Laser Operators:

Basic Laser Training	Job-Specific Training	Medical Surveillance	Printed Name	Signature	Owner/Oper. Initial/date
9/11/03		10/15/1990	Charles Carlson		